Class17_Vaccination

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Getting Started

Let's start by importing our data!

```
# Import vaccination data
vax <- read.csv("covid19vaccinesbyzipcode_test.csv")
head(vax)
```

```
##   as_of_date zip_code_tabulation_area local_health_jurisdiction    county
## 1 2021-01-05                   92804                    Orange    Orange
## 2 2021-01-05                   92626                    Orange    Orange
## 3 2021-01-05                   92250                  Imperial  Imperial
## 4 2021-01-05                   92637                    Orange    Orange
## 5 2021-01-05                   92155                 San Diego San Diego
## 6 2021-01-05                   92259                  Imperial  Imperial
##   vaccine_equity_metric_quartile                vem_source
## 1                              2 Healthy Places Index Score
## 2                              3 Healthy Places Index Score
## 3                              1 Healthy Places Index Score
## 4                              3 Healthy Places Index Score
## 5                             NA            No VEM Assigned
## 6                              1    CDPH-Derived ZCTA Score
##   age12_plus_population age5_plus_population persons_fully_vaccinated
## 1               76455.9                84200                       19
## 2               44238.8                47883                       NA
## 3                7098.5                 8026                       NA
## 4               16027.4                16053                       NA
## 5                 456.0                  456                       NA
## 6                 119.0                  121                       NA
##   persons_partially_vaccinated percent_of_population_fully_vaccinated
## 1                         1282                                0.000226
## 2                           NA                                      NA
## 3                           NA                                      NA
## 4                           NA                                      NA
## 5                           NA                                      NA
## 6                           NA                                      NA
##   percent_of_population_partially_vaccinated
## 1                                   0.015226
## 2                                         NA
## 3                                         NA
## 4                                         NA
```

```
## 5                                          NA
## 6                                          NA
##   percent_of_population_with_1_plus_dose
## 1                                0.015452
## 2                                      NA
## 3                                      NA
## 4                                      NA
## 5                                      NA
## 6                                      NA
##                                                                redacted
## 1                                                                    No
## 2 Information redacted in accordance with CA state privacy requirements
## 3 Information redacted in accordance with CA state privacy requirements
## 4 Information redacted in accordance with CA state privacy requirements
## 5 Information redacted in accordance with CA state privacy requirements
## 6 Information redacted in accordance with CA state privacy requirements
```

```
library(dplyr)
```

```
##
## Attaching package: 'dplyr'

## The following objects are masked from 'package:stats':
##
##     filter, lag

## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union
```

Q1. What column details the total number of people fully vaccinated?

The column "persons_fully_vaccinated" details the total number of fully vaccinated people.

Q2. What column details the Zip code tabulation area?

"zip_code_tabulation_area" column shows the zip code

Q3. What is the earliest date in this dataset?

```
head(n=1, vax$as_of_date)
```

```
## [1] "2021-01-05"
```

```
dplyr::first(vax$as_of_date)
```

```
## [1] "2021-01-05"
```

The earliest date is 2021-01-5

Q4. What is the latest date in this dataset?

```
dplyr::last(vax$as_of_date)
```

```
## [1] "2021-11-16"
```

The latest date is 2021-11-16

Calling skim!

```
skimr::skim(vax)
```

Table 1: Data summary

Name	vax
Number of rows	81144
Number of columns	14
Column type frequency:	
character	5
numeric	9
Group variables	None

Variable type: character

skim_variable	n_missing	complete_rate	min	max	empty	n_unique	whitespace
as_of_date	0	1	10	10	0	46	0
local_health_jurisdiction	0	1	0	15	230	62	0
county	0	1	0	15	230	59	0
vem_source	0	1	15	26	0	3	0
redacted	0	1	2	69	0	2	0

Variable type: numeric

skim_variable	n_missing	complete_rate	mean	sd	p0	p25	p50	p75	p100	hist
zip_code_tabulation_area	0	1.00	93665.11	1817.39	90001	92257.75	93658.50	95380.50	97635.0	
vaccine_equity_metric_quartile	1002	0.95	2.44	1.11	1	1.00	2.00	3.00	4.0	
age12_plus_population	0	1.00	18895.04	18993.94	0	1346.95	13685.10	31756.12	88556.7	
age5_plus_population	0	1.00	20875.24	21106.05	0	1460.50	15364.00	34877.00	101902.0	
persons_fully_vaccinated	8256	0.90	9456.49	11498.25	11	506.00	4105.00	15859.00	71078.0	
persons_partially_vaccinated	8256	0.90	1900.61	2113.07	11	200.00	1271.00	2893.00	20185.0	
percent_of_population_fully_vaccinated	8256	0.90	0.42	0.27	0	0.19	0.44	0.62	1.0	
percent_of_population_partially_vaccinated	8256	0.90	0.10	0.10	0	0.06	0.07	0.11	1.0	
percent_of_population_with_1_plus_dose	8256	0.90	0.50	0.26	0	0.30	0.53	0.70	1.0	

Q5. How many numeric columns are in this dataset?

9

Q6. Note that there are "missing values" in the dataset. How many NA values there in the persons_fully_vaccinated column?

There are 8256 NA values in this column

Q7. What percent of persons_fully_vaccinated values are missing (to 2 significant figures)?

```
(sum( is.na(vax$persons_fully_vaccinated) ) /
NROW(vax$persons_fully_vaccinated)) *100
```

```
## [1] 10.1745
```

10.17% of the data is missing here

Working with dates

```
#Let's use lubridate to make our lives easier when dealing with dates and times
#install.packages("lubridate")
library(lubridate)
```

```
##
## Attaching package: 'lubridate'
```

```
## The following objects are masked from 'package:base':
##
##     date, intersect, setdiff, union
```

```
#Specify our format
vax$as_of_date <- ymd(vax$as_of_date)
```

```
#Example of what we can now do easily
today() - vax$as_of_date[1]
```

```
## Time difference of 322 days
```

Q9. How many days have passed between the first and last day of the report?

```
vax$as_of_date[nrow(vax)] - vax$as_of_date[1]
```

```
## Time difference of 315 days
```

It has been 315 days since the first update and to the latest update

Q10. How many unique dates are in the dataset (i.e. how many different dates are detailed)?

```
NROW(unique(vax$as_of_date))
```

```
## [1] 46
```

There are 46 unique dates in the dataset

Working with ZIP codes

```
#Load first
library(zipcodeR)
```

```
geocode_zip('92037')
```

```
## # A tibble: 1 x 3
##   zipcode   lat   lng
##   <chr>   <dbl> <dbl>
## 1 92037    32.8 -117.
```

An example

```
#Calculate the distance between the centroids of any two ZIP codes in miles, e.g.
zip_distance('92037','92109')
```

```
##   zipcode_a zipcode_b distance
## 1     92037     92109     2.33
```

The distance between these two zip codes is 2.33 miles

We can pull census data about ZIP code areas (including median household income etc.). For example:

```
reverse_zipcode(c('92037', "92109", "92130") )
```

```
## # A tibble: 3 x 24
##   zipcode zipcode_type major_city post_office_city common_city_list county state
##   <chr>   <chr>        <chr>      <chr>                     <blob> <chr>  <chr>
## 1 92037   Standard     La Jolla   La Jolla, CA          <raw 20 B> San D~ CA
## 2 92109   Standard     San Diego  San Diego, CA         <raw 21 B> San D~ CA
## 3 92130   Standard     San Diego  San Diego, CA         <raw 21 B> San D~ CA
## # ... with 17 more variables: lat <dbl>, lng <dbl>, timezone <chr>,
## #   radius_in_miles <dbl>, area_code_list <blob>, population <int>,
## #   population_density <dbl>, land_area_in_sqmi <dbl>,
## #   water_area_in_sqmi <dbl>, housing_units <int>,
## #   occupied_housing_units <int>, median_home_value <int>,
## #   median_household_income <int>, bounds_west <dbl>, bounds_east <dbl>,
## #   bounds_north <dbl>, bounds_south <dbl>
```

```
# Pull data for all ZIP codes in the dataset
zipdata <- reverse_zipcode( vax$zip_code_tabulation_area )
```

Focus on the San Diego Area

Let's now focus in on the San Diego County area by restricting ourselves first to vax$county == "San Diego" entries. We can use base R or dplyr

```
library(dplyr)

sd <- filter(vax, county == "San Diego")

nrow(sd)
```

```
## [1] 4922
```

Using dplyr is often more convenient when we are subsetting across multiple criteria, for example all San Diego county areas with a population of over 10,000.

```
sd.10 <- filter(vax, county == "San Diego" &
                age5_plus_population > 10000)
```

Q11. How many distinct zip codes are listed for San Diego County

```
length(sd$zip_code_tabulation_area)
```

```
## [1] 4922
```

```
length(unique(sd$zip_code_tabulation_area))
```

```
## [1] 107
```

There are 107 unique zip codes listed for the county

Q12. What San Diego County Zip code area has the largest 12 + Population in this dataset?

```
ind <- which.max(sd$age12_plus_population)
sd[ind,]
```

```
##    as_of_date zip_code_tabulation_area local_health_jurisdiction    county
## 23 2021-01-05                   92154                San Diego San Diego
##    vaccine_equity_metric_quartile                vem_source
## 23                              2 Healthy Places Index Score
##    age12_plus_population age5_plus_population persons_fully_vaccinated
## 23               76365.2                82971                        32
##    persons_partially_vaccinated percent_of_population_fully_vaccinated
## 23                         1336                                0.000386
##    percent_of_population_partially_vaccinated
## 23                                   0.016102
##    percent_of_population_with_1_plus_dose redacted
## 23                               0.016488       No
```

The zip code is 92154, with 76365.2 people over the age of 12

What is the population of 92037 ZIP code area?

```
filter(sd, zip_code_tabulation_area == "92037")[1,]
```

```
##   as_of_date zip_code_tabulation_area local_health_jurisdiction    county
## 1 2021-01-05                   92037                San Diego San Diego
##   vaccine_equity_metric_quartile                vem_source
## 1                              4 Healthy Places Index Score
##   age12_plus_population age5_plus_population persons_fully_vaccinated
## 1               33675.6                36144                        44
##   persons_partially_vaccinated percent_of_population_fully_vaccinated
## 1                         1265                                0.001217
##   percent_of_population_partially_vaccinated
## 1                                   0.034999
##   percent_of_population_with_1_plus_dose redacted
## 1                                0.036216       No
```

```
sd_q13 <- filter(vax, county == "San Diego" & as_of_date == "2021-11-09")

nrow(sd_q13)
```

```
## [1] 107
```

Q13. What is the overall average "Percent of Population Fully Vaccinated" value for all San Diego "County" as of "2021-11-09"?

```
sd.now <- filter(sd, as_of_date=="2021-11-09")

mean(sd.now$percent_of_population_fully_vaccinated, na.rm = TRUE)
```

```
## [1] 0.6727567
```

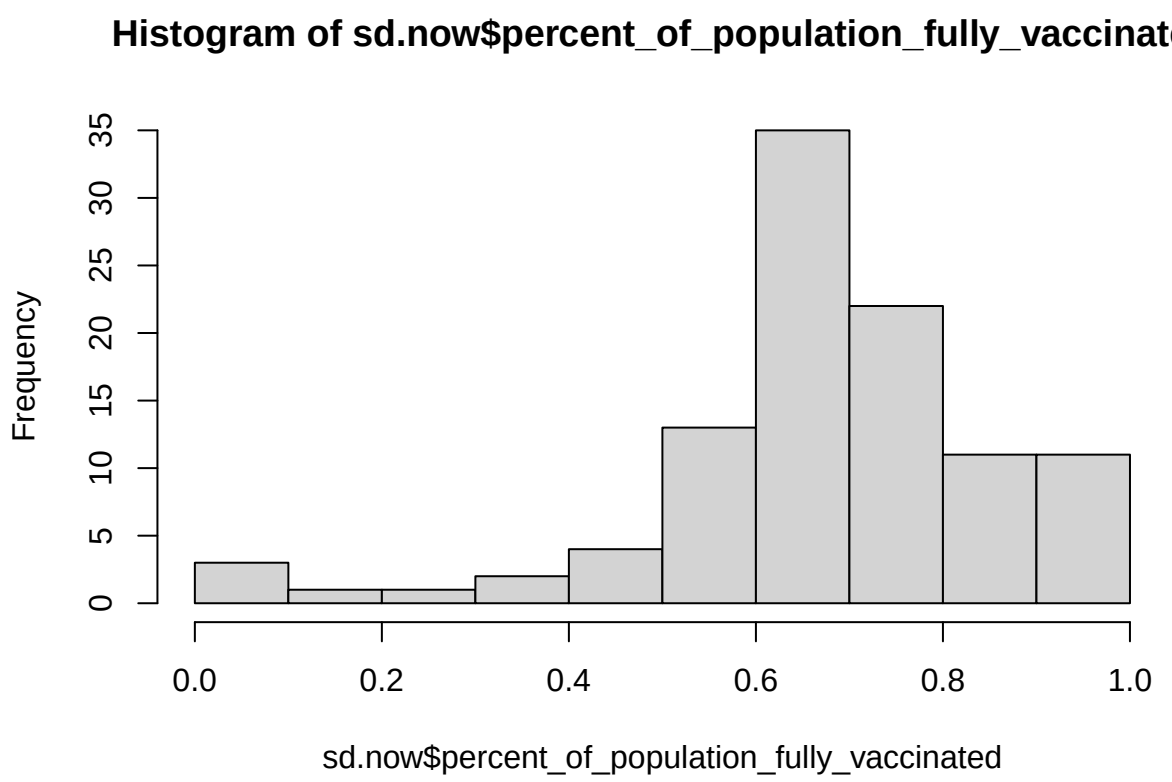
The average is 67.28%

```
summary(sd.now$percent_of_population_fully_vaccinated)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
## 0.01017 0.60776 0.67700 0.67276 0.76164 1.00000       4
```

Q14. Using either ggplot or base R graphics make a summary figure that shows the distribution of Percent of Population Fully Vaccinated values as of "2021-11-09"?

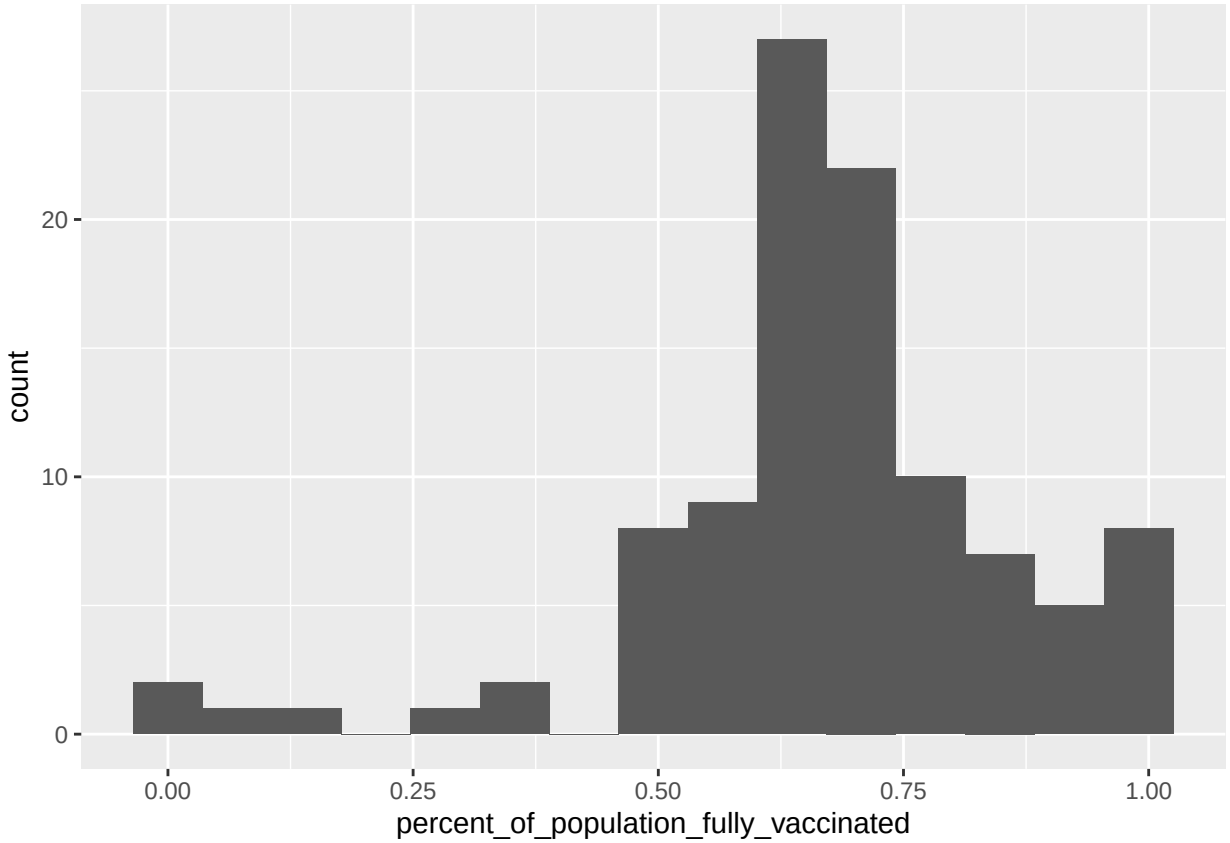
```
hist(sd.now$percent_of_population_fully_vaccinated)
```




```
library(ggplot2)

ggplot(sd.now) +
  aes(percent_of_population_fully_vaccinated) +
  geom_histogram(bins=15)
```

```
## Warning: Removed 4 rows containing non-finite values (stat_bin).
```




```
filter(sd.now, zip_code_tabulation_area == "92037")
```

```
##   as_of_date zip_code_tabulation_area local_health_jurisdiction    county
## 1 2021-11-09                   92037                San Diego San Diego
##   vaccine_equity_metric_quartile               vem_source
## 1                              4 Healthy Places Index Score
##   age12_plus_population age5_plus_population persons_fully_vaccinated
## 1               33675.6                36144                    32859
##   persons_partially_vaccinated percent_of_population_fully_vaccinated
## 1                         6354                                0.909114
##   percent_of_population_partially_vaccinated
## 1                                   0.175797
##   percent_of_population_with_1_plus_dose redacted
## 1                                      1       No
```

Focus on UCSD / La Jolla

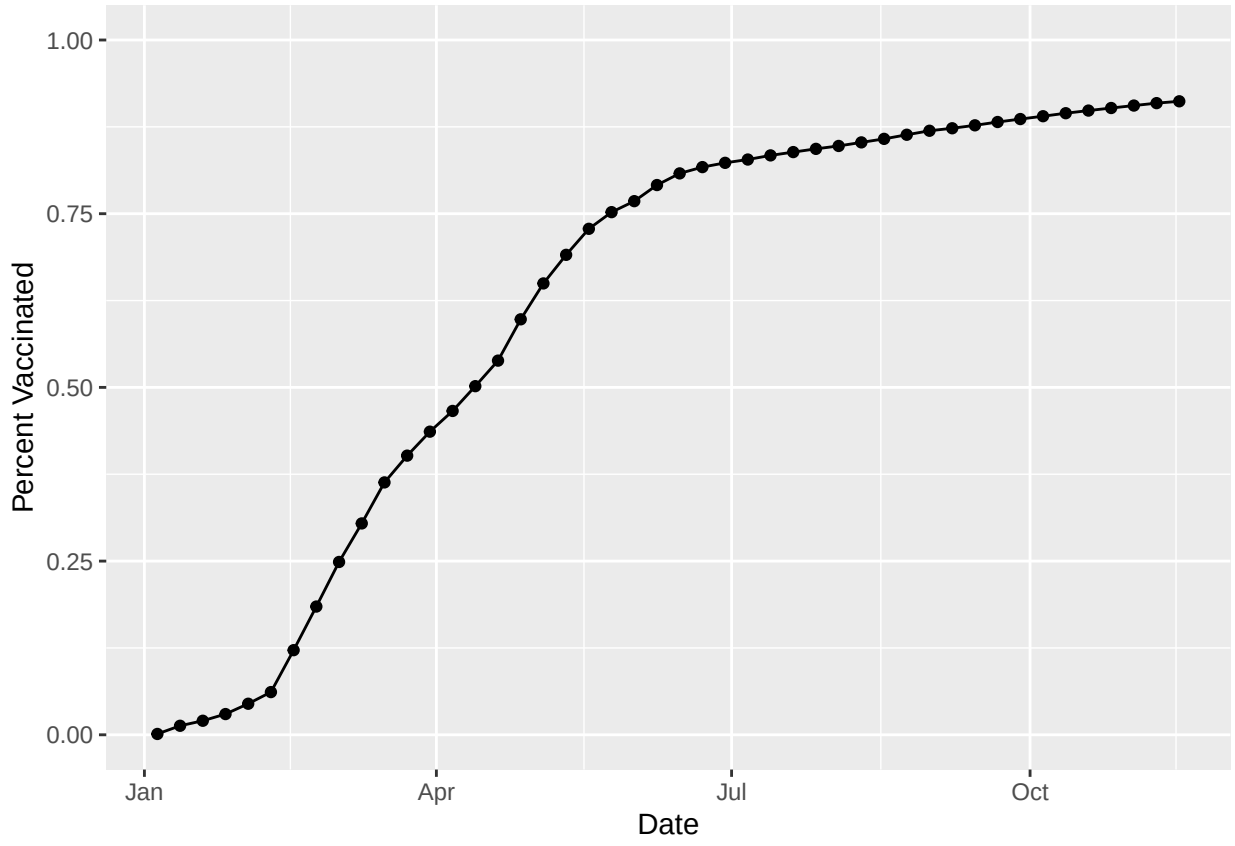
```
ucsd <- filter(sd, zip_code_tabulation_area=="92037")

#Age 5+ population
ucsd[1,]$age5_plus_population
```

```
## [1] 36144
```

Q15. Using ggplot make a graph of the vaccination rate time course for the 92037 ZIP code area:

```
ggplot(ucsd) +
  aes(x=as_of_date, y=percent_of_population_fully_vaccinated) +
  geom_point() +
  geom_line(group=1) +
  ylim(c(0,1)) +
  labs(x="Date", y="Percent Vaccinated")
```



Q16. Calculate the mean "Percent of Population Fully Vaccinated" for ZIP code areas with a population as large as 92037 (La Jolla) as_of_date "2021-11-16". Add this as a straight horizontal line to your plot from above with the geom_hline() function?

```
# Subset to all CA areas with a population as large as 92037
vax.36 <- filter(vax, age5_plus_population > 36144 &
                 as_of_date == "2021-11-16")

head(vax.36)
```

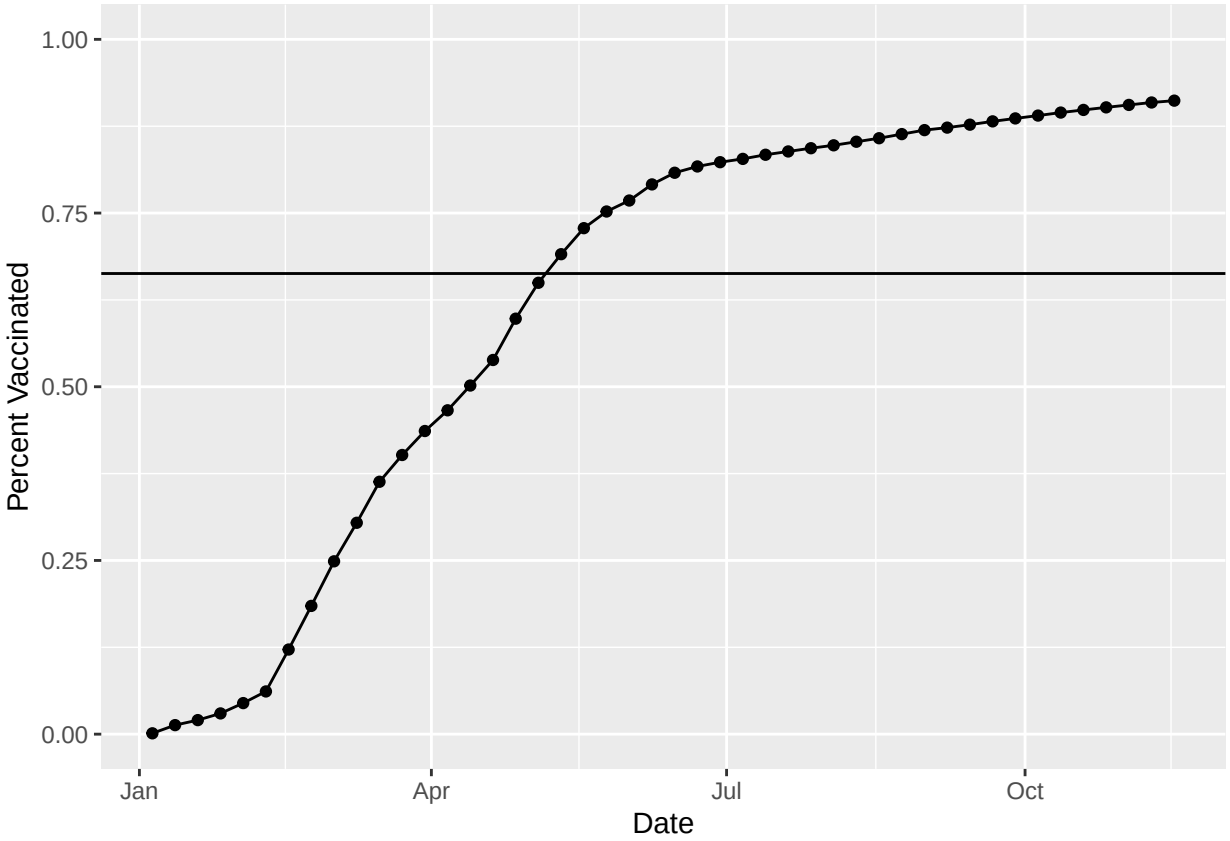
```
##   as_of_date zip_code_tabulation_area local_health_jurisdiction         county
## 1 2021-11-16                   92833                     Orange         Orange
## 2 2021-11-16                   92234                  Riverside      Riverside
## 3 2021-11-16                   92507                  Riverside      Riverside
```

```
## 4 2021-11-16                    92555                Riverside      Riverside
## 5 2021-11-16                    92345           San Bernardino San Bernardino
## 6 2021-11-16                    91306              Los Angeles    Los Angeles
##   vaccine_equity_metric_quartile                vem_source
## 1                              3 Healthy Places Index Score
## 2                              1 Healthy Places Index Score
## 3                              1 Healthy Places Index Score
## 4                              2 Healthy Places Index Score
## 5                              1 Healthy Places Index Score
## 6                              2 Healthy Places Index Score
##   age12_plus_population age5_plus_population persons_fully_vaccinated
## 1               43985.4                48623                    34668
## 2               46401.1                51202                    34191
## 3               51432.5                55253                    31704
## 4               36725.7                41446                    23776
## 5               66047.5                75539                    35332
## 6               42671.1                46573                    31858
##   persons_partially_vaccinated percent_of_population_fully_vaccinated
## 1                         3377                                0.712996
## 2                         3966                                0.667767
## 3                         3434                                0.573797
## 4                         2424                                0.573662
## 5                         4428                                0.467732
## 6                         3372                                0.684044
##   percent_of_population_partially_vaccinated
## 1                                   0.069453
## 2                                   0.077458
## 3                                   0.062150
## 4                                   0.058486
## 5                                   0.058619
## 6                                   0.072402
##   percent_of_population_with_1_plus_dose redacted
## 1                               0.782449       No
## 2                               0.745225       No
## 3                               0.635947       No
## 4                               0.632148       No
## 5                               0.526351       No
## 6                               0.756446       No
```

```
mean(vax.36$percent_of_population_fully_vaccinated)
```

```
## [1] 0.6629812
```

```
ggplot(ucsd) +
  aes(x=as_of_date, y=percent_of_population_fully_vaccinated) +
  geom_point() +
  geom_line(group=1) +
  ylim(c(0,1)) +
  labs(x="Date", y="Percent Vaccinated") +
  geom_hline(yintercept = .6629812)
```



Q17. What is the 6 number summary (Min, 1st Qu., Median, Mean, 3rd Qu., and Max) of the "Percent of Population Fully Vaccinated" values for ZIP code areas with a population as large as 92037 (La Jolla) as_of_date "2021-11-16"?

```
summary(vax.36$percent_of_population_fully_vaccinated)
```

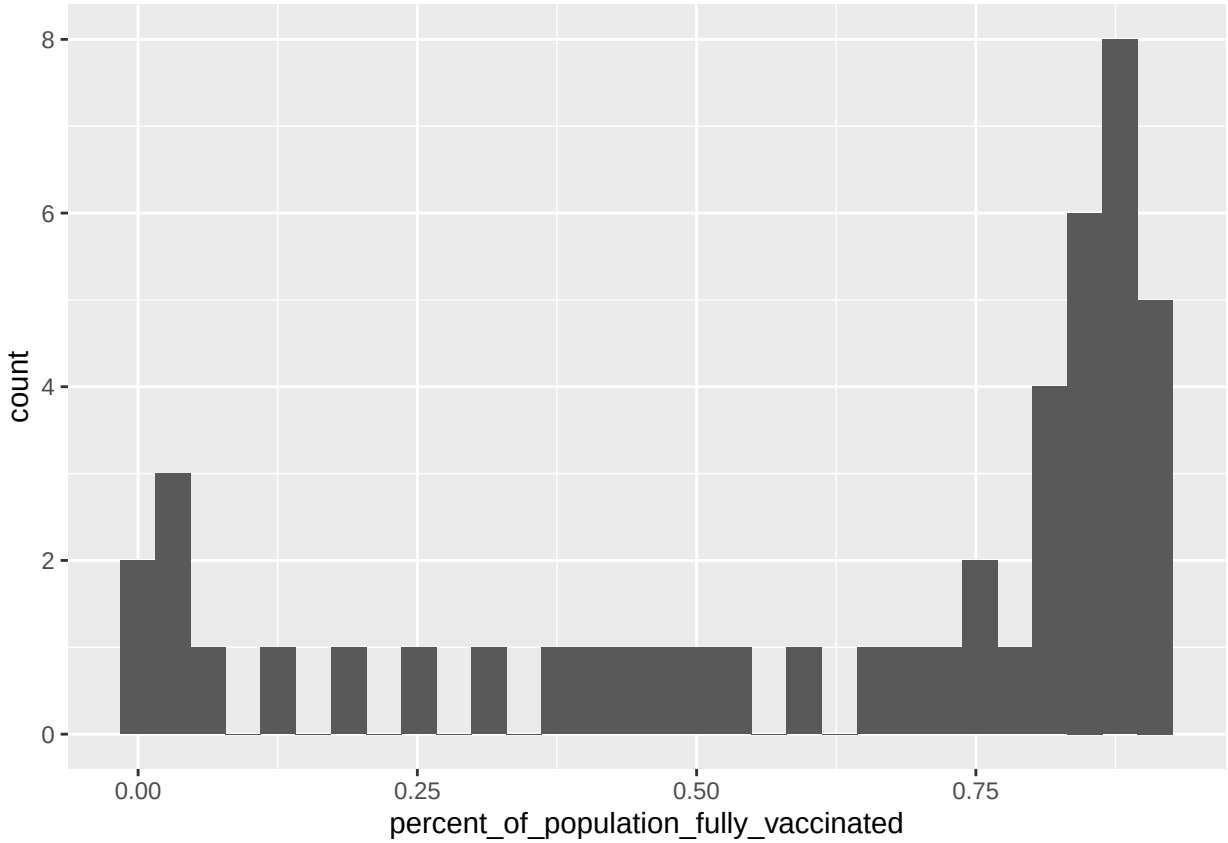
```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##  0.3519  0.5891  0.6649  0.6630  0.7286  1.0000
```

The average is 66.30%

Q18. Using ggplot generate a histogram of this data.

```
ggplot(ucsd) +
  aes(percent_of_population_fully_vaccinated) +
  geom_histogram()
```

```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```



Q19. Is the 92109 and 92040 ZIP code areas above or below the average value you calculated for all these above?

```
vax %>% filter(as_of_date == "2021-11-16") %>%
  filter(zip_code_tabulation_area=="92040") %>%
  select(percent_of_population_fully_vaccinated)
```

```
##   percent_of_population_fully_vaccinated
## 1                               0.520463
```

```
vax %>% filter(as_of_date == "2021-11-16") %>%
  filter(zip_code_tabulation_area=="92109") %>%
  select(percent_of_population_fully_vaccinated)
```

```
##   percent_of_population_fully_vaccinated
## 1                               0.687763
```

The average overal was 66.30%, so the 92040 average is lower at 52.04% The 92109 averave is higher at 68.77%

Q20. Finally make a time course plot of vaccination progress for all areas in the full dataset with a age5_plus_population > 36144.

```
vax.36.all <- filter(vax, age5_plus_population > 36144)


ggplot(vax.36.all) +
  aes(as_of_date,
      percent_of_population_fully_vaccinated,
      group=zip_code_tabulation_area) +
  geom_line(alpha=0.2, color="blue") +
  labs(x="Date", y="Percent Vaccinated",
       title="Vaccination Rate Across California",
       subtitle="Only areas with a population above 36k are shown") +
  geom_hline(yintercept = 0.66, linetype="dashed")
```

```
## Warning: Removed 180 row(s) containing missing values (geom_path).
```